THURSDAY, JUNE 10, 1886

THE 43-TON GUN EXPLOSION

THE bursting of the 43-ton gun on board the *Collingwood* has naturally attracted considerable attention from men of science as well as from the general public, and it may not be out of place at the present time to compare the ideas of scientific men with the data given in text-books published by authority and put into the hands of artillery officers for purposes of instruction.

The latest gunnery text-book is that compiled by Major Mackinlay, R.A., and published in 1883. In it is a table compiled by another artillery officer, in which is given the calculated and actual results obtained from all classes of ordnance, among them being the 12″ B.L. gun of 43 tons, Mark II., the gun which burst on board the *Collingwood.*

The powder charge is given as 286 lbs. prismatic, projectile 720 lbs.; the total work theoretically producible from the expansion of the charge in the bore 22,884 foot tons; the actual work produced in muzzle energy of projectile 17,180 foot tons. There is therefore, according to the table, a loss of 5704 foot tons to be expended—externally in expelling the powder gases, displacing the atmosphere, and recoil; internally in heating and stretching the gun, in friction of the gas check and gases, and rotating the shot.

In a lecture delivered in January 1885, just after the bursting of the *Active's* 6″ gun, Mr. Wm. Anderson pointed out that the lost work was very much greater than was usually imagined, and he went through a calculation on thermo-dynamical principles of the forces produced in a 10″ B.L. gun. Taking Mr. Anderson's formulæ and adapting them to the 12″ B.L. gun, we shall not have to proceed far before finding out how erroneous is the table given in the text-book. We will only examine the forces external to the gun (*i.e.* those producing recoil), as Mr. Anderson's accuracy on these points has been indorsed by Col. Moncrieff, C.B., F.R.S., and we shall neglect internal forces employed in friction stretching and heating the gun—forces difficult to estimate, and on which there is some difference of opinion.

As to the energy of the projectile there can be no question, but taking the terminal pressure at 3 tons (we believe it has risen as high as 5·5 to 6 tons) the energy of the expelled gases is 12,208 foot tons, that expended in lifting the atmosphere 2501 tons, together 14,714 foot tons; so that, neglecting internal forces altogether—and these are no small quantity—we have 14,714 foot tons of energy against 5704 in the text-book.

We can only conclude that the pressure corresponding to this difference, as well as that due to the forces expended inside the bore, have been entirely neglected by the designers of the guns.

The powder with which the gun was burst was that known as "cocoa"; this powder, while diminishing the maximum pressure carries it further down the bore (a most dangerous thing for guns weak in the chase), and increases the mean and final pressures, and the muzzle velocity; therefore the calculation we have given is probably within the mark for an equal weight of cocoa powder.

The reason for the errors we have pointed out may probably be found in the blind confidence placed in the indications of crusher gauges. It is well known that a certain length of time must be taken up in the compression of all metals, and it is extremely doubtful whether something near the two-hundredth part of a second in which the explosion takes place is sufficient for the compression of copper cylinders, especially when comparisons are made between those near the breech, which are longer under the influence of the powder gases, and those in the muzzle, which are not acted on for any appreciable time.

The only item in the above estimates which has been ascertained by experiment is the muzzle velocity, the others are the result of calculation, and although Col. Moncrieff tells us they are to be trusted when measured in recoil, it would be far more satisfactory were they ascertained by direct experiment.

Means for verification have been pointed out, and although we believe the Government is provided with the instruments nothing has yet been done with them.

The failure of the *Collingwood's* gun raised hopes in the minds of many that at last a proper inquiry into the question would be held; but it has been referred back to the same Committee, associated with the same civilians (except Mr. Leece, who is dead), who recommended that the gun "should remain unaltered," but that "the charge of 295 lbs. of cocoa powder should not be exceeded."

They therefore are to sit in judgment on themselves, and if they relied on the same data when recommending certain additional strength should be given to other guns, as they did when merely limiting the charge of the 12″, what reason is there for supposing that the results with other guns will differ from this one except in loss of life and damage done?

GEOLOGY OF TURKESTAN

Turkestan; a Geological and Orographical Description based upon Data collected during the Journeys of 1874 *to* 1880. By J. V. Moushketoff. Pp. 714. With Map and Engravings. Russian. (St. Petersburg, 1886.)

FOR several years past all who take an interest in Central Asia have followed with great interest the yearly reports published by Profs. Romanovsky and Moushketoff on their geological explorations in the mountains of the Tian-Shan, the high plateaux of the Pamir, and the lowlands of the Amu-daria. The extensive character of these explorations, prosecuted for several consecutive years, and the practical experience of the two Russian geologists promised that new light would soon be thrown on several important but doubtful points in the geology of this most interesting region; but the appearance of their works has been delayed for some years. We have, however, now before us the first volume of M. Moushketoff's work, and when the whole, which will comprise three large volumes, as also M. Romanovsky's work on the same subject, is published, we shall have an almost complete picture of the geology of this region which contains the key to so many important geological questions in Europe.

The first volume of M. Moushketoff's "Turkestan" consists of two parts. The first is an analysis of all explorations made in Turkestan up to 1884; and, the literature of the subject being scattered in periodicals, it will be of great value for the geographer. All the Russian and English explorations are mentioned, and the chief of them briefly analysed. The second part contains a description of the journeys of the author in the "Turan or Aral basin," including Samarkand, the western outskirts of the Tian-Shan, the valley of Ferganah, the western outskirts of the Pamir and Alay region, the valley of the Amu-daria from Termez to Khiva, and the Kyzylkum sands. A summary concludes the volume, which is accompanied by a novelty that will agreeably surprise geologists, namely, a geological map of Russian Turkestan, on a scale of 67 miles to an inch. Another map, on a scale of 20 miles to an inch, is in course of preparation, that now published being only intended to show the extension and limits of four great geological subdivisions: the Post-Tertiary deposits; the Tertiary, together with the Chalk, Jurassic, and Trias; the Primary, including the Archæan crystalline slates; and the unstratified crystalline rocks (granites, porphyries, diabases, and so on). Of course, it is regrettable that the Secondary deposits could not be separated from the Tertiary; but we must wait for the appearance of the promised map on a larger scale.

As to the conclusions arrived at in this volume, we may remark at once that the personal inclinations of the author being chiefly directed to petrography on the one hand, and dynamic geology on the other, these two departments have received most attention; while Prof. Romanovsky, being a well-known palæontologist, has devoted his chief attention and wide practical knowledge to the discrimination of the different subdivisions of the sedimentary deposits explored by him. M. Romanovsky having published almost every year very valuable reports on his summer's work, his researches are embodied in M. Moushketoff's work, so that each is complementary to the other.

Nearly the whole of the Aral basin (and we have seen that the author includes under this name the wide tracts east and south-east of Lake Aral) is covered by Chalk, Tertiary, and Post-Tertiary deposits; the remaining portion, that is, no more than one-twentieth of the area, being occupied by crystalline unstratified rocks, metamorphosed slate, and Palæozoic deposits which appear from below the above. A mere glance at a topographical map of the region would be sufficient to indicate their extent—all the hills rising amidst the wide steppes being built up of Palæozoic or Archæan rocks. The Devonian limestones of the mountains Urda-bashi and Karatash; the syenites, diabases, and crystalline slates of the Mogol-tau, Kochkar-ata, and Karnak mountains; and the Devonian and Carboniferous limestones of the Kazy-kurt hills are in this category. Some gold, silver-and-lead ores, copper, as also almandine and beryl, are found in these mountains. It is interesting also to notice that the crystalline rocks in the Palæozoic islands scattered amidst the steppes are much more metamorphosed than the corresponding rocks in the Tian-Shan mountains. They have obviously been long subject to the influence of water, which once covered what is now the steppe region.

Jurassic deposits are the next geological formation found in the East Aral basin. The lowest strata seem, however, to belong to the Rhætic subdivision—the few remains of plants which they contain being some of them Jurassic, while others should be recognised as Rhætic, and the third Triassic. They contain no traces of marine origin, and only one fresh-water shell, the *Anadonta boroldaica*, Romanovsky. It must therefore be concluded that throughout the Triassic and Jurassic periods nearly all Turkestan was a land having on its borders numerous lakes containing sweet or brackish water. These Jurassic deposits appear only on the borders of the East Aral basin: namely, on the Baidam and Saram rivers, and in Ferganah; in the west they are known on the Mangishlak peninsula (Caspian). Everywhere they contain most valuable deposits of coal. We may add that the geologist will thus find, in the Aral basin, the well-known geological feature so characteristic of the structure of East Siberia and Manchuria.

Chalk and Tertiary deposits are widely spread. They constitute the bottom of nearly all the basin, and reach a thickness of 2000 feet in Ferganah, and 5000 feet in the Hissar region. Two systems of dislocation are pretty well observed amidst these deposits which are folded in two chief directions: north-east (60°) and north-west (60°). This observation of M. Moushketoff is well worthy of notice. We thus find, on the outskirts of the hilly tracts of Asia, the two great systems of upheavals which are so characteristic of Asia: the system of ridges and plateaux running from south-west to north-east, which we have found appearing with such persistency in the East Siberian hilly tracts; and the north-western direction, which appears predominantly in South-West Asia.

The Chalk deposits show great variety of structure: sandstones, limestones, and marls predominating. As to their fossils, they appear at some places in immense masses, but the number of species is mostly limited. According to M. Romanovsky, the Upper and Middle Chalk are represented there: the former, very rich in oysters, is closely akin to the Senonian of Europe; it is much developed on the outskirts of the Tian-Shan, especially in Ferganah, but it changes its characters (Senonian Ammonites making their appearance) farther west, in the lower parts of the Amu-daria. The Middle Chalk, which, however, it is difficult to separate from the former, has a still wider extension. The Chalk contains a number of useful minerals; namely, phosphorite, gypsum, naphtha, ozokerite, and sulphur.

The Tertiary deposits are so closely connected with the Chalk deposits that it is often difficult to separate them from one another; they are still poorer in fossils (excepting those on the northern and western shores of Lake Aral, as yet unexplored), especially towards the east, as we approach the Tian-Shan. In this last region we have, as is known, the Eocene deposits, consisting for the most part of deep-sea deposits of Nummulite sandstones. They are covered with Lower and Middle Oligocene, very much like the German and Belgian Tertiary deposits, and these last in their turn disappear under Miocene limestones and Sarmatian clays.

The Tertiary deposits of the Tian-Shan contain, on the contrary, very little or no clays, and chiefly consist of conglomerates and sandstones. Some of them date from the Eocene period, some others from the Oligocene; while the most recent Miocene and Pliocene deposits contain a fauna in process of decay: the deep-sea fauna of the banks of the Aral is substituted by a shallow-water fauna, and the Nummulite banks disappear. The chief fossils are teeth of sharks, some Lamellibranchiata, and a few oysters (*Sphenia rostrata*, Lamk.; *Modiola subcarinata*, Lamk.; *M. jeremejewi*, Roman.; *Alligator darwini*, Ludw.; *Ostrea raincurti*, Desh.; *O. longirostris*, Lamk., &c.). These features, as also the extension of pudding-stones, especially on the outskirts of the Tian-Shan, are indicative of their littoral origin. The same distinction appears as to the minerals they contain. Several great beds of gypsum, brown-coal, and bituminous slates are found in the Tertiary deposits around Lake Aral, as also naphtha in the Balkhan mountains; but both naphtha and brown-coal are absent in the Tian-Shan deposits, which contain, on the contrary, salt, together with gypsum.

The Post-Pliocene Aral-Caspian deposits can hardly be delimitated from the Tertiary deposits. Their maximum thickness does not exceed 100 feet. Both in the Black-Sands (Kara kum) and the Red-Sands (Kyzyl-kum) they consist of a sandy clay which often passes upwards into a clayey sandstone. As to their petrographical features, they are the same from the Volga to the foot of the Tian-Shan. The fossils they contain (*Cardium edule*, *Dreyssena polymorpha*, *Neritina liturata*, *Adacna vitrea*, and *Hydrobia stagnalis* in the Kara-kum; *Lithoglyphus caspius*, *Hydrobia stagnalis*, *Anadonta ponderosa*, and the Spongia described as *Metschnikowia tuberculata* by M. Grimm in the Kyzyl-kum) are all now living in the Caspian and Lake Aral, and precisely in the littoral shallow-water zone.

What are the limits of this immense Post-Pliocene basin surely forms one of the most interesting problems of geology, and they can already be determined approximately. In the west, the Ergeni hills (which run due south of the great Tsaritoyn bend of the Volga) form its western shore[1]—a great gulf extending along the broad valley of the two Manych rivers towards the Black Sea. Further south it must have been much nearer to the present shore of the Caspian, with a broad gulf to the west in what is now the valley of the Kura. How far this gulf extended towards the north remains still unsettled. The evidence derived from the *Dreyssena polymorpha*, found as far north as the Samara winding of the Volga, is still contested by MM. Möller and Grimm—this species of *Dreyssena* being a too cosmopolitan one; but the discovery of a few Caspian mussels even further north, towards Simbirsk, as well as the orography of this region, make one incline to the opinion that a narrow gulf of the Aral-Caspian Post-Pliocene sea extended almost as far as the mouth of the Kama, with a wide lake filling up the Oka depression of the Volga and communicating with the sea by an outlet. It is known that this basin extended towards Lake Aral and further east, with a peninsula which entered it from the north, and which is now known as the Ust-urt and Mugo-djar hills. How far it extended towards the east remains still unsettled. M. Moushketoff only mentions the supposition of the late M. Severtsoff as to the connection which existed between Lake Aral and Lake Balkhash. However probable this connection, we ought to take into consideration the latest researches of Russian zoologists, according to which the fauna of Lake Balkhash would have much more kinship with the lakes of Central Asia than with the fauna of Lake Aral. If this fact is confirmed, we should probably distinguish two different periods—an earlier and a later one—during which last the connection between Lake Balkhash and Lake Aral was broken, but continued between the former and the eastern lakes of Central Asia.

As to the southern limits of the Aral-Caspian basin, they cannot yet be determined with certainty. Aral-Caspian deposits are wanting in the middle parts of the Kyzyl-kum plateau, so that the southern shores of this basin must have been somewhere in the latitude of the Bukan-tau mountains. Further east they ran in a more southern latitude. In the Sary-kamysh depression and for 160 miles further south we again find Aral-Caspian mussels, as far as the Bala-Ishem wells, and in this region the Uzboy (formerly considered as the old bed of the Amu) disappears. South of Lake Aral they hardly reach the latitude of Merv. From all these data, M. Moushketoff concludes that the basin consisted of two different parts—the Caspian and the Aral part—connected by a narrow outlet passing by the base of the Balkhan mountains. The eastern portion was shallower than the western; it had more islands, and its organic life was poorer. It was also subdivided, in its turn, into two parts connected by the Aibughir outlet.

As to the drying up of this basin and its subsequent modifications, which M. Moushketoff attributes in great part to the agency of the wind, we shall devote to them a second article, inasmuch as the author's observations on the dunes and moving sands deserve special attention.

P. K.

(*To be continued.*)

THE NATURALIST'S DIARY

The Naturalist's Diary. Arranged and Edited by Charles Roberts, F.R.C.S., L.R.C.P., &c. (Swan Sonnenschein, Le Bas, and Lowry, Paternoster Square).

THIS book may be described as a most excellent *vade mecum* and guide to any person who not only wishes to keep a phenological diary, but who wishes to know what to enter therein. The preface and introduction show forth the principles which have guided the author in making this compilation, and the important services it may be made to render to biologists and to men of science, as well as to practical gardeners, agriculturists, sportsmen, and residents in the country generally. It is also recommended to the notice of tourists, and especially to those who find themselves perchance perforce anchored in some one of our numerous health resorts, cut off from their usual avocations. Mr. Roberts's observations have been made on the breezy downs of Marlborough in connection with the Marlborough College Natural History Society, 1864-84. They include registration of mean, maximum, and minimum temperature in sun and shade, "accumulated temperature" above 42° day-degrees, barometrical observations, rainfall, and direction of wind.

---

[1] Prof. Barbot-de-Marny, whose deep insight and keen observation are so highly esteemed, extended these limits further west. Several considerations derived from the orography and physical geography of the region give, in my opinion, great probability to M. Moushketoff's view on the question. He has also had the opportunity of making a more thorough exploration of the region.